COPING BEHAVIORS OF SPOTTED DOLPHINS DURING FISHING SETS

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ABSTRACT

The tuna purse seine fishery in the ETP has targeted dolphins to capture associated tuna. Currently, dolphin mortality is at sustainable levels, however, there is concern that fishing operations may be causing chronic stress in these animals, affecting their populations. The aim of this study was to assess behavioral changes of dolphins during the fishing sets (chase, capture, encirclement with net, and backdown, which is the sinking of the cork-line to release the dolphins from the net) in order to know more about their coping strategies. If dolphins are habituated this will be reflected in their ability to predict events during the fishing set. Behavioral observations were carried out on dolphins chased and encircled during August-October 2001 in the ETP. A combination of scan and behavioral sampling was carried out in each of the fishing sets through direct observations and video-recording, in order to obtain information on individual and group behaviors. The percentage of dolphins milling and in passive behaviors was positively related to the duration of the encirclement ($p<0.05$), while the proportion of dolphins in active behaviors was related to the duration of the backdown ($p<0.001$). The frequency/min of jumps was also positively related to the duration of chase ($p<0.05$) and duration of the set ($p=0.05$). When behaviors were compared by school size captured it was found that the proportion of dolphins 'swimming moderate' during the set and the proportion of dolphins engaged in active behaviors during the backdown of the net were significantly greater in small schools than in large schools ($p<0.05$, $p<0.01$; respectively). In 76.9% of sets, dolphins already released tried to get back into the net compass. From these results we suggest that most dolphins predict the events of the fishing operations, however it still important to understand the function of many of the behaviors recorded and how they relate to physiological responses.

INTRODUCTION

Fishery Background

For many decades, the tuna purse seine fishery in the eastern tropical Pacific Ocean (ETP) has targeted dolphins to capture associated tuna (Hall, 1998). Although there are no detailed mortality data available during the early years of fishing on dolphins (1950-1972), high levels of mortality were recorded for several species of ETP dolphins (Paez, 1994; Wade. 1995)**.** After development and implementation of the backdown procedure, a method of releasing captured dolphins alive, the mortality of dolphins decreased gradually between the 1970s and 1990s. Currently, dolphin mortality is at sustainable levels (Wade, 1995), however, there is concern that fishing operations may be causing chronic stress in these animals. It is still unclear how dolphins cope with the chase, encirclement, capture, and backdown during a set, and as a result how this relates to the welfare of individuals. As in other species, long-term welfare problems may depend on the intensity of those events and the way in which the animals respond to them.

Physical and Psychological Stress

The welfare of an individual is defined as the state of an individual in relation to its attempts to cope with its environment (Broom, 1988). To better understand the way we can assess animal welfare, it is useful to know the neuroendocrine responses involved when animals face physical and psychological stress. Stress is defined as an environmental effect on an individual that overtaxes its control systems and reduces its inclusive fitness (Broom and

Johnson, 1993). Different studies with humans and animals have been useful to understand the neuroendocrine mechanisms that are involved when mammals are exposed to adverse environmental effects (Sapolsky, 1998). When the duration and intensity of a stress factor are transitory, physiological effects are beneficial and the animal experiences no adverse consequences. However, when a stress factor is intense and chronic, the prolonged activity of the sympathoadrenal and adrenocortical axis can cause cardiovascular, digestive and metabolic disease, and can inhibit the immune response, reproduction, and growth, as well as causing behavioral changes (Nelson, 2000). In this sense a series of short and long-term welfare indicators have been proposed, including: behavior, adrenal activity, immune response, reproductive function, disease, opioids, among others (Broom and Johnson, 1993). Some studies of stress in bottlenose dolphins have linked acute stress to some types of capture (Thomson and Geraci, 1986; St. Aubin, et al., 1996). To date, no measurements of possible long-term welfare problems have been made in ETP dolphins.

Behavior of Dolphins During Fishing Sets

Behavioral measurements are a useful indicator of how animals cope with stress and may reflect differences in the way dolphins perceive events such as chase, encirclement, backdown, and handling. It has been observed that not all dolphins behave in the same way during a fishing set (Norris et al., 1978; Pryor and Kang Shallenberger, 1991; Sevenbergen, 1997). St. Aubin et al. (1996) suggest that there can be habituation to subsequent captures as a result of learning. Observers in the ETP fishery have also reported seeing passive groups of dolphins drifting towards the release area as the ship pulls the net during backdown (Norris et al., 1978). When the dolphins perceive that they are free of the net they almost immediately streak away from the seiner. This almost instantaneous change in behavior from total passivity to high-level activity suggests that the dolphins in the net are not in a catatonic state. Furthermore, dolphins in high density fishing areas appear more experienced at evading chase and encirclement than dolphins with less experience in areas of lower fishing intensity (Heckel et al., 2000).

Although the causal factors of these differences in behavior and their biological function are not known, it is possible that they are related to the ability to predict an upcoming stressful event. The potential stress caused by the seining procedure is expected to vary and may be influenced by the perception of the animal to the stressor. From studies in domestic animals it is known that the same stressor produce different coping responses between individuals. The type of stress, the intensity and duration of the stress factor, as well as individual differences related to age, sex, and previous experience are related to habituation to a stress factor (Mendl and Deag, 1995). Therefore it is hypothesized that the behaviors shown by the dolphins during a fishing set can provide information on the way these individuals cope with that event. Furthermore, the duration of the different periods of the fishing set can be related to those behaviors. If the dolphins are exposed to a more prolonged and intense procedure it is possible that they will show different behaviors than dolphins that are exposed to shorter fishing sets.

In addition, individual differences in the ability to perceive and cope with the acute stress of fishing activities may be related to the size of the school captured. This hypothesis is based on social structure and the ability of individuals to recognize other dolphins in the captured school. It is known from studies in farm animals that the ability to recognize an individual in a group can modulate a stress response (Fraser and Broom, 1990). For example, the presence of a familiar social partner particularly in the case of the mother-young relationship can modulate cortisol response to a stressor (Lyon et al., 1988). Therefore it is possible that there are differences in

changes in school structure and individual recognition between large and small schools, eliciting different types of coping behaviors.

The objective of this study is threefold: (1) To determine whether differences in duration of the set, including chase, encirclement, capture, and backdown, affect the behavior of dolphins in the net; (2) to determine whether dolphin behavior changes with the size of the school captured; and (3) to qualitatively examine aspects of set operations during the Chase Encirclement Stress Studies (CHESS, Forney et al., 2002) compared to actual fishing operations by the Mexican tuna fishing fleet.

An independent scientific peer review of this work was administered by the Center for Independent Experts located at the University of Miami. Responses to reviewer's comments can be found in Appendix II.

METHODS

Research Cruise

Behavioral observations were carried out on dolphins chased and encircled as part of the overall CHESS program (Forney et al., 2002), conducted during August - October 2001 in the ETP. Most of the dolphins were offshore spotted dolphins (*Stenella attenuata*), but some mixed schools of spotted and spinner dolphins (*Stenella longirostris*) were also encircled. Due to small sample sizes, however, only observations of spotted dolphins were analyzed in this study. The observations were carried out (by Eduardo Santurtún) from a commercial tuna fishery boat working in cooperation with researchers aboard the NOAA research vessel *McArthur*.

Behavioral Observations and Measurements

A combination of scan and behavioral sampling was carried out in 14 research sets through direct observations and video-recording, in order to obtain information on individual and group behaviors (Martin and Bateson, 1993). During the 14 sets in which it was possible to observe the behavior of the dolphins, scan samples were used in 11 sets and behavior sampling (video) was used in all sets. Scans were not considered in the first three sets as they were used for direct pilot observations. Beginning in the fourth set, scans were conducted every 4 minutes with long distance binoculars starting with the first scan after the helicopter landed and encirclement was complete. In each scan an estimate of the percentage of dolphins engaged in different states of behavior was recorded (Appendix 1). In between scans, video recording (digital video-recorder, 700x) was used during a 4 min interval before the next scan. During those 4 min behavior sampling with continuous recording was carried out in order to collect information on the frequency of events of behavior (Appendix 1). The total number of scans and the duration of the video recording varied with the total duration of each set. At the end of the cruise, 13 hours of video taken during 14 different sets were reviewed. Additional data were obtained from standard forms completed by the fishery observer placed aboard the seiner by the Inter-American Tropical Tuna Commission (IATTC). Based on the IATTC observer records, each set was divided into four observation periods:

1) Chase (from 'helicopter over dolphins' to 'let go')
2) Encirclement (from 'let go' to 'rings up')
3) Capture (from 'rings up' to 'backdown beginning' recorded by the IATTC observer)

4) Backdown (until last dolphin is released).

During each set and set period, the proportion of individuals in different states of active and passive behaviors (Appendix I) was calculated, as well as the frequency/min of active events of behavior (Appendix I). States were considered when the behavioral patterns were prolonged, and events were recorded when the behaviors were discrete. A behavior catalogue was adapted from Allen et al, (2000) and from records provided by the *Programa Nacional para el Aprovechamiento del Atún y Protección al Delfín (PNAAAPD).* States were categorized into active and passive behaviors; events only included active behaviors. Active behaviors included rapid locomotion swimming patterns on the surface of the water, while passive behaviors did not include locomotion, except for milling which is defined as slow diving up and down in a concentric area. The behaviors considered were (see Appendix I for definitions):

- Active states of behavior: swimming fast, and swimming moderate.
- Passive states: spy, floating, and milling.
- Active events: lob tailing, aerial activity, swimming fast with aerial activity.

Information Obtained from IATTC Observer

The variables considered from the information obtained by the IATTC observer were: duration of each period/set, school size captured, number of dolphins released by backdown and released actively. These variables were related to the behavioral measurements described above.

Information Obtained from the Instituto Nacional de la Pesca (INP), SAGARPA

The information provided by the INP included the average duration of backdown, average duration of set, average of school size captured, average number of dolphins released by backdown, and average number of dolphins released actively (by handling) during 1998, 1999, and 2000.

Descriptive Records of Events During Backdown

With the aid of an underwater observer, records of some behavioral events, including defecation, sexual behaviors, vocalizations, agonistic interactions (defined as any interaction which included aggressive and evasive type of behaviors), resting on the net, and scratching with the net, were obtained in 8 sets where sufficient personnel could be deployed into the net. In addition, records of dolphins swimming back and forth from the tuna boat to the backdown area of the net and attempttiings to get back into the net compass were recorded from the video-recordings. This information was only used descriptively to express the percentage of sets where the behavior was seen performed by one or more dolphins.

Statistical analysis

The duration of the sets or periods, the number of dolphins captured, and the proportion of dolphins released by backdown vs. released actively by swimmers were related to the proportion of dolphins in all states of active and passive behaviors, and to the frequency of active behavior events. Spearman correlations were used to investigate relationships. In addition, a comparison of behaviors between types of schools was carried out using a Mann-Whitney U test. Two types of school were categorized according to the number of individuals captured. A school was classified as small when less than 100 dolphins were captured and as large when more than

100 dolphins were captured. The significance level was set at $\alpha = 0.05$ for all tests. No statistical comparison of the set characteristics for actual fishing operations and CHESS sets was possible, because the fishing data were provided only in summary form, without measures of variance.

RESULTS

Relationships Between Behavior States and Events and Duration of Sets

The distribution of the proportion of dolphins in different states of behavior during each fishing set, as well as the distribution of the frequency/min of the active events can be seen in Tables 1 and 2 respectively. It is important to notice that with the exception of the last set (27), the behavior 'swimming fast' was not seen in any of the dolphins captured (Table 1).

When the duration of chase, encirclement, capture, backdown, and total duration of set were related to the percentage of dolphins in different states of active and passive behaviors, as well as with the frequency/min of active behavior events, some significant correlations were found (Table 3). In general, the percentage of dolphins in passive behaviors was increased with duration of encirclement and capture, while the percentage of dolphins in active behaviors was related positively to the duration of the backdown.

The Effect of School Size

When behaviors were compared by school size category (large vs. small), it was found that the proportion of dolphins 'swimming moderate' during the capture period and during the entire set was greater in small schools than in large schools ($U=1$, $p=0.01$; $U=2$, $p=0.02$, respectively) (Santurtún, Fig. 1). The proportion of dolphins engaged in active behaviors during the backdown of the net was significantly greater in small schools than in large schools ($U=0.5$, $p<0.01$) (Santurtún, Fig. 1). No other differences were found in the occurrences of behaviors for small vs. large captured schools. When the means of sets durations of large and smalls groups were compared no differences were found ($p>0.05$).

A negative correlation was found between the number of dolphins captured with the proportion of dolphins 'swimming moderate' ($R=-0.77$, $p<0.05$). No other correlation with group size was significant.

The percentage of dolphins released by backdown and released actively was not significantly different between different school size categories ($p>0.05$). There was a tendency for more dolphins to be released by backdown during sets with a greater proportion of dolphins 'swimming moderate' during backdown ($Rs= 0.53$, $p<0.08$). No other relationships were found with behavior. The number of dolphins released by backdown was negatively correlated with the duration of the chase ($Rs= -0.57$, $p= 0.03$).

Set Characteristics for 1998-2000 Fishery Sets and CHESS Sets

As the summarized data obtained for the commercial fisheries sets from 1998-2000 did not allow a statistical comparison with the CHESS set characteristics, the information is presented in a descriptive way (Table 4).

Underwater and surface behaviors during backdown.

Underwater behaviors were recorded in 8 sets. Defecation was seen in one or more dolphins in 50% of sets, mating behavior in 62.5% of sets, agonistic interactions in 37.5% of sets, vocalizations were recorded in all sets, and in 12.5 % of sets resting behavior on the net was

observed by one or more individuals. From the video-recordings it was seen that in 76.9% of sets, one or more dolphins already released from the net tried to get back into the net compass. In 86.6% of sets, some individuals were observed swimming back and forth from the tuna boat to the backdown area of the net.

DISCUSSION

The observation that more dolphins showed passive behaviors during encirclement and more active behaviors during backdown could support the idea that they anticipate the different procedures of the fishing set, and it may suggest a sign of habituation as a result from learning (Pryor and Kang Shallenberger, 1991). Norris et al. (1978) have previously described the occurrence of passive behaviors in spotted dolphins during encirclement, and in another study, St. Aubin et al. (1996) suggested that semi-domesticated dolphins had lower levels of cortisol than wild dolphins, possibly as a result of a learning process from repeated capture. Also the increase in active swimming behaviors as the backdown duration increases could indicate that the dolphins are anticipating backdown and increasing their activity level in preparation for the release. From studies in farm animals it is known that previous rough handling is related to stressful responses, and that previous non-painful handling can result in habituation and less stress (Grandin, 1995). Still, the question of how this apparent habituation in dolphins is related to physiological responses of stress has to be answered.

Although interpretation of the significant correlations must be cautious, the association of the duration of encirclement with more dolphins showing passive behaviors may suggest something about a coping strategy of the dolphins inside the net (Mendl and Deag, 1995). In this sense, it may be more convenient for dolphins that cannot swim away from the net to adopt a more passive behavior that could help them to recover from the acute physical stress of the chase. As mentioned before, the significance of those behaviors has yet to be determined, and their possible relationships with exertional myopathy should be examined. Also, it would be important to know more about the possible biological function of passive and active behaviors when not exposed to fishering activities.

The size of the school captured also appears to have an effect on the behaviors shown. Small groups were generally more active than larger groups. Availability of space and social grouping could explain these differences in behavior. It is possible that having fewer individuals in a captured group allows the dolphins to move more freely in the area of encirclement and to engage in more active behaviors. On the other hand, social separation could be playing a role as well (Curry, 1999). Smaller captured groups are more likely to include separation of social subgroups (such as mother/calf pairs), which could increase the frequency of active or agitated behaviors. The observation that in 77% of sets some dolphins tried to swim back over the cork line into the net lends support to the latter hypothesis.

The variation seen in the number of dolphins captured per set during CHESS was expected, as on some occasions, the research intentionally limited the number as well as the composition of dolphins captured to reduce the risk to dolphins and research personnel during handling and biological sampling operations, and to allow targeted recapture of previously marked dolphins. It is possible that this aspect could have created an experimental bias in the behavioral recording, and in the future it is suggested that an attempt be made to measure the behavior of dolphins captured during actual commercial fishing operations. A similar percentage of dolphins were released by backdown (as opposed to manual release by swimmers over the

corkline) during CHESS as compared to standard fishing operations. In both data sets the high percentage of animals released by backdown suggests that the dolphins are familiar with the backdown procedure, and that the fishing crew are skilled in conducting this technique. It is important to state that the data provided from fishing operations did not separate fishing sets according to season of the year or location of captures. It is worthwhile to compare in further analyses the specific data from time of year and location of operations.

Signs of reactivity when animals experience fear is well-documented in domestic animals (Broom and Johnson, 1993). As suggested by Pryor and Kang Shallenberger (1991) events of active behaviors in captured dolphins could be a sign of fear. If this is the case, the fact that the duration of the chase and set appear to relate to aerial activity could mean that some dolphins will react with these signs of agitation if the acute stress of the set is prolonged. The observation of behaviors such as defecation, aggression, vocalizations, (Broom and Johnson, 1993), and mating behavior (Fowler, 1995) may indicate short-term welfare problems for captured dolphins. In this study the information on the percentage of sets where some dolphins were seen defecating, mating, vocalizing, resting on the net, or interacting aggressively support the hypothesis that some individuals are showing signs of fear. However, as it was not possible to determine the frequency of these behaviors in each set or the number of individuals performing these behaviors, this information can only be considered qualitatively and should be interpreted with caution.

Overall, from the results presented it seems that the duration of the set and the size of the school captured may be related to the type and nature of the stressor and to the way individual dolphins cope with fishing operations. It is important to emphasize that there were several limitations in this study regarding the procedure for estimating the number of dolphins captured and released, the ability to see all the behaviors from a distance, and the few opportunities to observe the frequency of underwater behaviors. Furthermore, the fact that it was not possible to obtain information from focal recaptured dolphins prevents us from fully understanding the biological and physiological significance of many of the behaviors seen. This would be necessary in order to measure a possible cumulative effect of recapture on dolphin behavior and its relationships with pathophysiological measurements. Nevertheless, a more integrated understanding of the significance of the behaviors recorded may be obtained by combining physiological and behavioral variables in the future.

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Table 1. Percentage of dolphins in different states of active (a) and passive (p) behaviors during each set.

Set	Swimming moderate(a)	Swimming fast(a)	Total Active	Rafting (p)	Floating (p)	Milling (p)	Total Passive
5	17.8	0	8.9	2.1	8.2	2.1	4.1
6	17	0	8.5	3.6	8.4	2.3	4.7
9	12.5	0	6.3	2.3	3.8	0	2.0
11	20.9	0	10.5	1.1	4.1	0	2.6
20	14.1	0	7.1	0.8	0.4	1	0.7
21	10.7	0	5.4	1.4	3.4	1.3	2.0
22	16.9	0	8.5	1.7	2.7	0.2	1.5
23	34	0	17	0.8	5.6	0.8	2.4
24	10.9	0	5.5	0	1.9	0	0.6
25	9.7	0	4.9	5.8	14.7	1.2	7.2
27	21.3	6.3	13.8	3.5	7.3	0	3.6

Table 2. Frequency/min of active events of behavior during each set.

Set	Lob tailing	Aerial activity	Swimming fast with aerial activity	Total Active
2	0.08	0.04	0.12	0.24
3	0.00	0.00	0.00	0.00
4	0.01	0.01	0.00	0.02
5	0.09	0.00	0.24	0.33
6	0.02	0.01	0.00	0.03
9	0.35	0.00	0.04	0.39
11	0.00	0.00	0.00	0.00
20	0.27	0.04	0.06	0.37
21	0.15	0.07	0.15	0.37
22	0.17	0.03	0.14	0.34
23	0.17	0.01	0.11	0.29
24	0.09	0.02	0.02	0.13
25	0.15	0.00	0.02	0.17
27	0.14	0.00	0.02	0.16

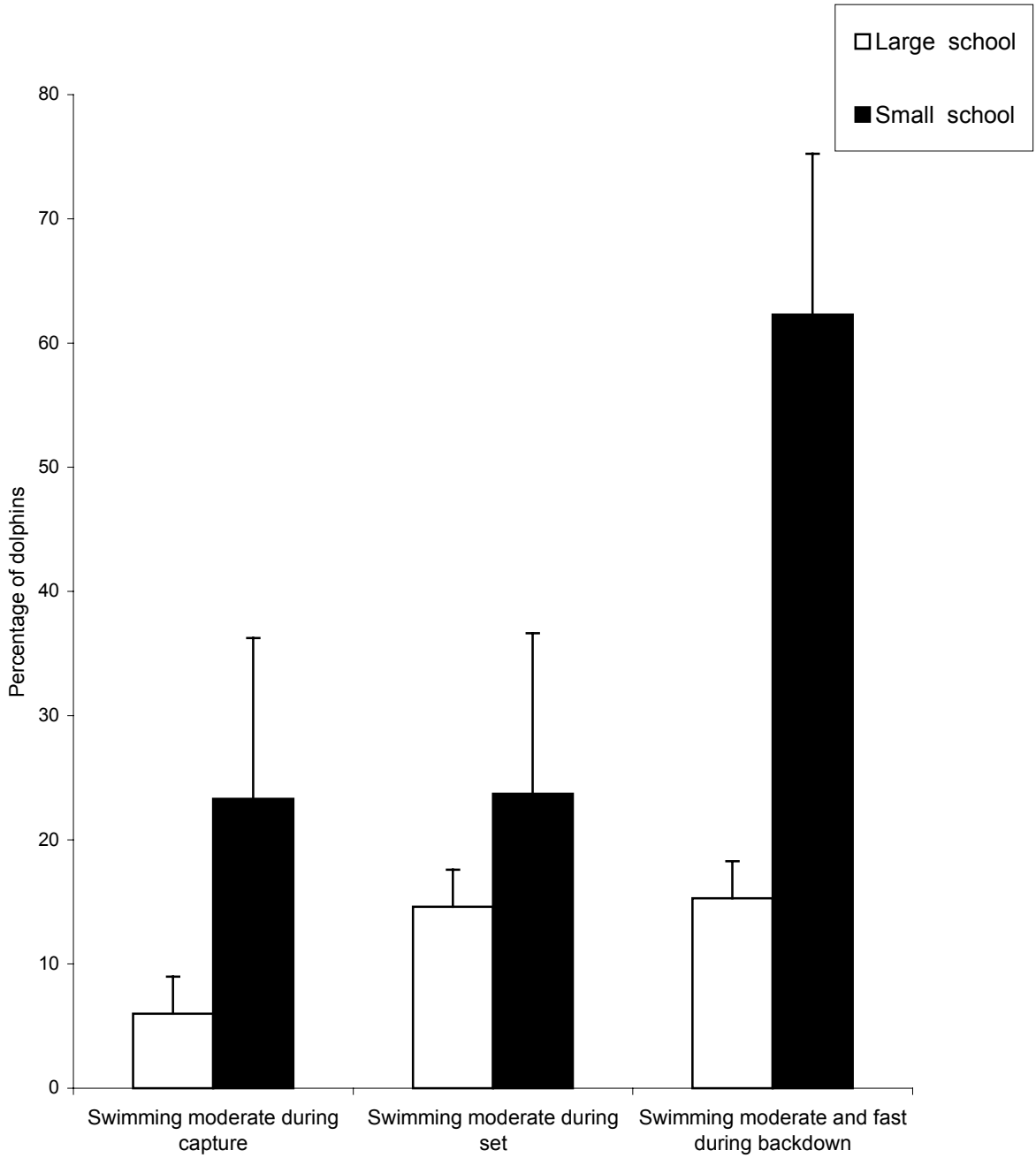
Table 3. Significant relationships of the percentage of dolphins in different states of behavior and frequency of events of behavior with duration of set periods and total set duration.

Behavior	Chase	Encirclement	Capture	Backdown	Set
Dolphins milling during set	n.s.	n.s.	Rs=0.83, p=0.01	n.s.	n.s.
Dolphins milling during encirclement	---	Rs=0.73, p=0.04	---	---	---
Dolphins in passive behaviors during encirclement	---	Rs=0.6, p=0.04	---	---	---
Dolphins in active behaviors during backdown	---	---	---	Rs=0.73, p=0.0001	---
F/min of aerial activity during set	Rs=0.54, p=0.04	n.s.	n.s.	n.s.	Rs= 0.53, p= 0.05

Table 4. Duration of backdown, duration of sets, number of dolphins captured, as well as the percentage of dolphins released by backdown and actively for the commercial fisheries 1998-2000 (avg.), and in each of the CHESS sets. (Missing information corresponds to sets where the IATTC observer was not able to record any data).

Sets	Duration of backdown (min)	Duration of set (min)	Number of dolphins captured	Percentage of dolphins released by backdown	Percentage of dolphins released actively
1998	14.4 (avg.)	156.0 (avg.)	280.7 (avg.)	95.6 (avg.)	4.4 (avg.)
1999	15 (avg.)	163.8 (avg.)	399.6 (avg.)	95.9 (avg.)	4.1 (avg.)
2000	16.2 (avg.)	160.8 (avg.)	398.4 (avg.)	96.3 (avg.)	3.7
CHESS-1	61	145	120	-	-
CH-2	125	239	350	95.7	4.3
CH-3	38	130	70	85.7	0
CH-4	21	132	6	16.6	-
CH-5	4	139	100	100	0
CH-6	50	183	20	90	5
CH-7	34	122	150	98	2
CH-8	46	146	35	97	3
CH-9	28	119	100	100	0
CH-11	38	122	3	0	100
CH-12	-	154	3	-	-
CH-13	5	143	29	-	-
CH-14	9	136	27	-	-
CH-15	-	-	33	-	-
CH-16	7	123	24	-	-
CH-17	1	117	15	-	-
CH-18	1	116	33	-	-
CH-19	3	138	46	-	-
CH-20	24	115	120	33	67
CH-21	36	119	150	96.6	3.4
CH-22	39	134	35	100	0
CH-23	44	133	14	100	0
CH-24	47	132	11	100	0
CH-25	41	137	20	100	0
CH-27	50	137	20	100	0

Figure 1. Comparison of the median percentage of dolphins swimming moderate during capture and during set, and swimming moderate and swimming fast during backdown for large and small schools.



APPENDIX I --

Behaviors recorded during sets

States

Active behaviors

Swimming Fast - When traveling or locomotion is performed rapidly and with abrupt changes in direction.

Swimming Moderate – When traveling or locomotion is performed not at high speed with less abrupt changes of direction.

Passive behaviors

Milling - The dolphins swim slowly, surfacing within a small area of the net compass.

Floating - The dolphin is suspended on the surface of the water in a horizontal position.

Rafting or spy - The dolphin is suspended on the surface in vertical position with only the head visible at or above the surface.

Events

Active behaviors

Lob tailing - One individual slapping the surface of the water with the tail flukes, creating splashes.

Aerial activity - One individual "head slapping".

Swimming fast with aerial activity –One individual performing a rapid, directed swimming with aerial activity (jumps).

APPENDIX II –

Responses to reviewer's comments

- General comments:

1) Some parts of the introduction have been removed or modified to better understand the context of the work.

2) As it was not a significant behavior due to its very low frequency and presentation in different sets, and in order to avoid misunderstanding with the definition of rafting used for passive states of behavior, "spy or rafting with aerial activity" has been removed.

3) After consulting with an statistician, the information on the comparisons of the data from the commercial fisheries with CHESS set characteristics, did not allow statistical analysis and the information is presented in a descriptively form.

4) After incorporating the comments made by the referees, the discussion has been rewritten to have a more coherent order of ideas.

- *Comments to referees:*

1. Dr. Daniel Martineau,

1) His suggestion on the possible relationships between the occurrence of sexual behaviors and stress is very useful and has been incorporated into the discussion.

2) Also, his suggestion on the possible relationships between EM and passive behaviors has been incorporated into the discussion.

2. Dr. Rudy Ortíz,

1) Although an explanation of how space could influence the differences found between small and large school had been given, emphasis has no been put on that aspect in the text.

2) A suggestion is made to include the number of dolphins released in the two types of schools. It is possible that the referee missed this point in the discussion as it was already included in the text and as explained, no differences were found between sizes of herds captured.

3. Dr. Gregory D. Bossart,

1) We agree with Dr. Bossart's comment on the need to address the question on "desensitization" with backdown. We have added a comment on the need to understand the biological function of those behaviors.

2) As mentioned before (Referee 1) we have added a comment on the possible relationships of mating behavior with stress.

3) We agree as well with this referee in the sense that it is possible to have a bias in data recorded according to the type of captures made. We have also incorporated a comment on this.

4. Dr. Sylvaine de Guise,

1) As suggested by this referee, it would be important to know more about the possible biological function of passive and active behaviors when not exposed to the fishery boat. This of course will help to know more about the context of the occurrence of these behaviors during capture. Although, we do not have that information, a comment has been made in that respect.

2) The question on "How often do the dolphins display behaviors, such as defecating or mating is also an interesting one, as knowing the frequency/time unit of such stressful events can be helpful to know more about the intensity of the stressors". However, the way the underwater behaviors were sampled did not allowed this type of records. This limitation is considered in the discussion.

3) We do not agree with this referee in the comment that it may be "difficult to accept an interpretation of coping when the normal behavior is not defined.". We believe that although the normal behavior of dolphins is not known, there is a clear evasive behavior of dolphins when the chase begins, suggesting that it is a stressful event. In that sense the concept of coping, referred as having control of mental and bodily stability (Fraser and Broom, 1990), or the ability to tolerate different degrees of stimulation (Broom and Johnson, 1993) could be applied.

4) A comment on the benefit of having information of recaptured individuals is already mentioned in the text.

5) We do not entirely agree with the comment that "the argument that the animals are repeatedly captured argues against one of the premises of CHESS that recapture will increase the stress level compared to the first capture". As far as we know the hypothesis presented in CHESS let the possibility of having less intense responses at every recapture.

5. Dr. Janet Mann,

1) We agree as well with this referee in the sense that scan method, video recording and the number of sets done need to be described in more detail. We have incorporated a comment on this.

2) The definition of Rafting used is taken from records provided by the Programa Nacional para el Aprovechamiento del Atún y Protección al Delfín. Rafting and floating are two different behaviors.

3) Agonistic interaction is defined in the text.

4) Spy with aerial activity has been removed (see general comments).

5) The concept of one-zero sampling was intended to be used to fit the descriptive record underwater into a type of behavioral record, and was not intended to "compare the prevalence between set variables" However, we believe that we can omit the use of that concept in order to avoid misunderstanding of the type of record used. We have modified the text and explained that a descriptive record was used for underwater observations.

6) The data from the commercial sets and CHESS were just used in a descriptive way (see general comments).

7) We agree as well with this referee of some comments of the labels and information of figure 1, 2 and table 1. We have modified this.